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CHEMICAL & ENGINEERING
NEWS

Chemical earnings stagnate in fourth quarter Page 16

PRELIMINARY PROGRAM ACS spring meeting, Miami Beach Page 39

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# Federal R&D Budget

Defense once again bumps total upward Page 10

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■ **USS Agri-Chemicals to be purchased by a group of company's managers.** **Page 7**

■ **NBS develops computer model of fire phenomena to be used by building and product designers and fire experts.** **Page 7**

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## News Focus

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# Funds for R&D Are Up 13% in Administration's Budget Proposal

## The proposed increase of $7 billion for defense accounts for the entire rise in federal R&D spending for fiscal 1986; nondefense R&D would suffer a net loss

**Janice R. Long and David J. Hanson,** C&EN Washington

The fiscal 1986 R&D budget is more frost bitten than frozen in the proposal President Reagan sent to Capitol Hill earlier this month. Total R&D funding is up 13% to $57.6 billion in a total proposed budget that is up only 1% to $938 billion.

However, there is an element of smoke and mirrors in this fiscal 1986 R&D budget. As is the case in the total budget, the 22% or $7.1 billion increase set for defense R&D spending is greater than the overall $6.6 billion increase in total R&D funding. Thus, in the proposed budget, funding for nondefense R&D is actually down 3% to $18.2 billion.

Overall funding for basic research is up 1%, or $76 million, to $7.9 billion. Here again the 16% or $133 million increase slated for basic defense research is more than the total increase. Nondefense basic research funding is down $57 million to $6.9 billion. Funding for R&D facilities is also down, off 7% to $2.1 billion. Most of the decrease owes to postponing or stretching out the construction of major new facilities.

It must be obvious by now that the Department of Defense is once again the big winner in the Administration's latest R&D budget proposal. Its research, development, testing, and evaluation funding comprises more than two thirds of the entire federal commitment to research. In fact, at more than $39 billion, it totals more than the entire federal R&D budget did in 1983. A budget this large will offer a tempting target as Congress seeks ever more ways to reduce federal spending.

As usual, most of the defense increase is devoted to development of advanced tactical weapons systems, such as the JVX aircraft and the C-17 transport aircraft. But the more basic research portion, known as the technology base, of the defense R&D budget also is slated for a 13% increase to $3.5 billion, which will be distributed fairly evenly among the three major services and the several defense agencies.

One new initiative in the fiscal 1986 budget is aimed at strengthening DOD's ties with universities. About $25 million is set aside for graduate scholarships and assistantships. This is the first time DOD has offered such assistance. The funds are targeted to go to those students working on defense-related research and emerging technologies. Total support for universities in the DOD budget amounts to about $900 million, according to defense department sources, of which up to $500 million would support basic research. Out of these basic research funds, DOD estimates about $76.6 million will go directly to basic research in chemistry. This is a 9% increase from fiscal 1985 support of about $70 million.

Among the defense agencies, the most significant budget increase is for the Strategic Defense Initiative,

### Glossary of budget terms

**Fiscal year.** Year running from Oct. 1 to Sept. 30. The fiscal year is designated by the calendar year in which it ends.

**Obligations.** Commitments made by federal agencies to pay out money for products, services, or other purposes, as distinct from the actual payment.

**Outlays.** Payments for obligations incurred under Congressionally granted budget authority generally made by issuance of checks on the Treasury. Outlays during any fiscal year may be for obligations incurred in prior fiscal years or in the same fiscal year.

**Rescission.** Enacted legislation canceling budget authority previously granted by Congress. Rescissions proposed by the President must be approved by Congress within 45 days to become effective.

Note: The R&D numbers obtained from individual agencies frequently differ from those used by the Office of Management & Budget in preparing its analysis of total federal R&D funding.

the so-called Star Wars program. Funding for this program is slated to increase 166% over fiscal 1985 to $3.7 billion. Of this huge amount, about $1.4 billion would go for surveillance, tracking, and other data assessments, and more than $1.8 billion for development of directed energy and kinetic energy weapons.

In contrast to DOD, the budget of the second largest supporter of R&D—the Department of Health & Human Services—would fall 6% to $4.8 billion. Within that amount, the budget for the National Institutes of Health would decline 5% to $4.4 billion.

The smoke and mirrors trick is nowhere more evident than in NIH's budget proposal. Even though the budget has been cut, Administration officials maintain that it will allow NIH to continue its normal practice of funding 5000 or so new and competitive research grants and providing support for 500 research centers around the country. Once awarded, the grants usually are supported for three years, with funding being provided annually. NIH has asked for $3.6 billion to support these activities in fiscal 1986, the same amount it requested in fiscal 1985.

However, Congress, in setting final fiscal 1985 budget totals, added $250 million to that NIH budget request. The money was to be used to increase from 5000 to 6500 the number of new grants funded. Once these 1500 additional grants were funded, NIH would have had to continue supporting them for two additional years, adding to its budget total—something that would have been counter to the Administration's goal of cutting or at least freezing government spending.

So going directly against the wishes of Congress, and making a wide departure from usual funding procedures, NIH has decided to spend all the fiscal 1985 money Congress provided, but it is supporting only the usual number of new research grants. That number is being kept constant by providing three-year funding for 650 of the 5000 grants and two-year funding for 45 of the research centers.

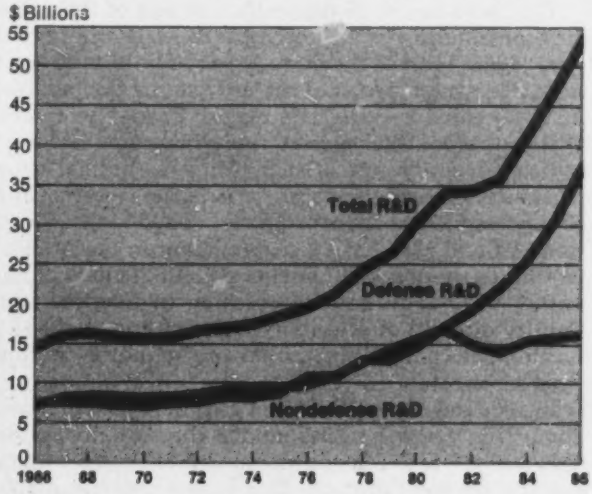
On the face of it this decision is legally correct. All the money appropriated by Congress will be used to support research grants. And NIH won't incur the future costs it would have if 1500 more grants had been funded. However, this budgetary sleight of hand is not appreciated by Congress. Rep. Henry A. Waxman (D.-Calif.) already has introduced a joint resolution restating Congress' intent for NIH to fund 6500 new grants.

The third largest supporter of R&D is the Department of Energy, and in light of its proposed 13% cut in total budget to $12.4 billion, the 6% cut in its R&D budget to $4.6 billion may not seem too drastic. However, when one factors out the $58 million, or 3% increase, set for weapons R&D and testing, civilian R&D funding would be down 11% to $2.7 billion.

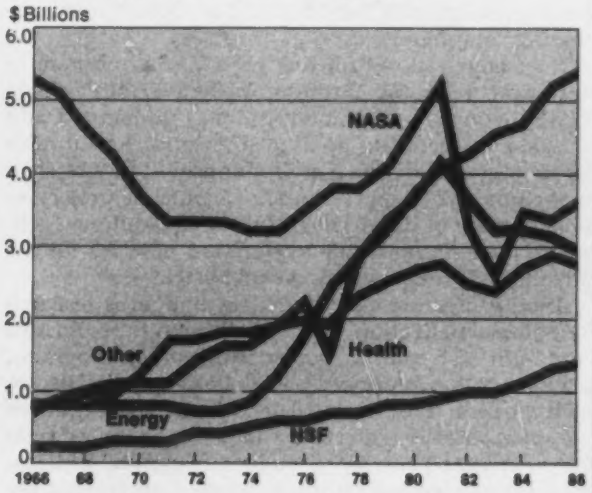
Even funding for DOE's supporting research and technical analyses programs, which has exhibited strong growth in other tight budget years, is scheduled to be down 4% to $427 milllion. Within that category, total funding for the chemical sciences program would decrease slightly to $94.2 million because of a 5% cut to $5.8 million in the construction budget.

Operating expenses for the chemical sciences program will be frozen at the 1985 level of $79.5 million, necessitating some selective termination of projects. Research areas of emphasis include photochemistry, chemical physics, atomic physics, the basic chemistry of coal, catalytic phenomena, separations, analytical techniques, and chemical thermodynamics. Operation of both the National Synchrotron Light Source facility and the Combustion Research Facility would be funded at the same level as in 1985. About $6.7 million of the capital equipment budget, frozen at $8.8 million, will go to meet the continuing need of scientists for state-of-the-art instrumentation, according to DOE budget books.

**Twenty years ago defense accounted for 48% of R&D spending; now it's 70%...**




**...and health has gone from 10% to 34% of the nondefense budget**




Source: Office of Management & Budget

DOE's budget for materials sciences would decline 5% to $183 million, owing to a 33% cut to $29.0 million in the construction budget. However, even though drastically reduced, the budget will provide $17.4 million for a new surface science and catalysis laboratory and an advanced materials laboratory at Lawrence Berkeley Laboratory's Center for Advanced Materials Research.

The operating expenses budget for materials sciences actually would increase 4% to $139 million. Priority research areas in 1986 include synthesis, alloying, preparation of new materials and structures, and materials characterization and property measurements using highly advanced techniques.

Funding for another part of the supporting research and technical analysis program, university research support, would drop 13% to $9.7 million. Funding for university research instrumentation would be down 1% to $4.5 million.

Sliding very steeply is DOE's fossil energy R&D funding, down 30% to $243 million. Within that program, funding for coal R&D, which includes a fair amount of chemical research, would decrease even more—41% to $149 million. However, funding for university coal research would rise 33% to $5.9 million, allowing for the awarding of 30 research grants in fiscal 1986, up from 20 in the current year.

Some other agencies fare much better in Reagan's budget proposal. For instance, for the National Aeronautics & Space Administration, the President has requested $7.9 billion, of which almost $3 billion is slated for R&D. One of the biggest items in this request is $230 million for continuing development of the space station. NASA Administrator James M. Beggs says that this is about $50 million less than the agency had sought for the station, but it is more than the $150 million being spent this year. Other programs at NASA scheduled for increases include space transportation development and research on planetary exploration and space applications. Research funding on physics and astronomy would decrease about $47 million in fiscal 1986 as some programs, such as the Hubble space telescope and the Gamma Ray Observatory, are nearing completion.

The budget allows for one new NASA program to start next year, the Orbiting Maneuvering Vehicle (OMV), which is a remotely piloted unmanned and reusable spacecraft to be used to extend the shuttle's capabilities. Beggs says that the funds will be stretched to include two Congressionally mandated projects—development of the Advanced Communications Technology Satellite and the acceleration of work on the Advanced Turboprop Propulsion System.

Another new item in the NASA budget is research for commercialization of space. Although begun this year with $8.5 million pooled from other programs, the agency has proposed $30 million specifically for such work in 1986. Related to this are the flights of the space shuttle, which may have to be reduced over the next year because of budget restraints and less than anticipated use by the military. Commercial use of the shuttle is progressing as expected, Beggs says.

The news is also good at the National Science Foundation, where the total budget would be up 7% to $1.6 billion. NSF's research budget also would rise 7%, to $1.4 billion. In addition, the chemistry division's budget would be up 7% to $93.5 million. However, the number of senior investigators supported is remaining constant at about 875 so that average grant size can be maintained close to this year's level.

Cutting across all of the research directorates, funding for research instrumentation is scheduled to be up 13% to $271 million, with funding for research equipment by the mathematical and physical sciences directorate up 15% to $102 million. The college science instrumentation program will provide matching funds of $5 million for the acquisition of equipment by four-year colleges.

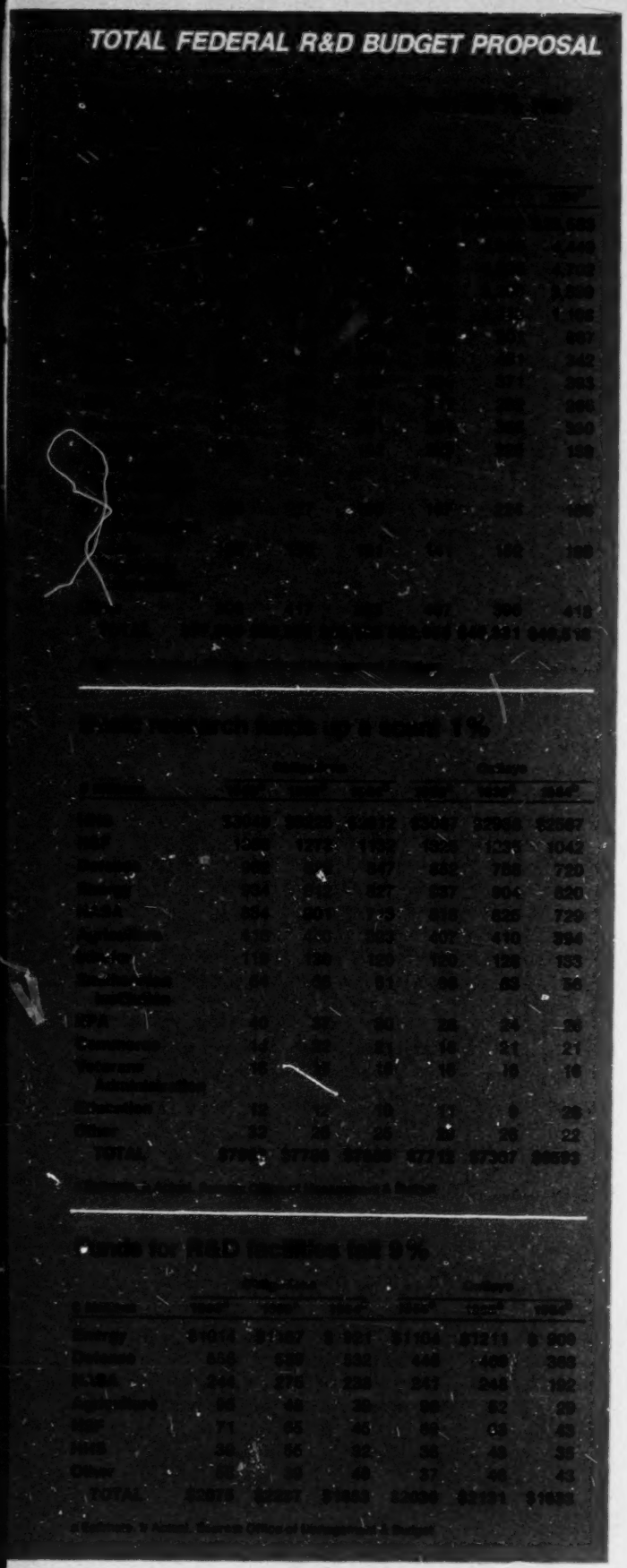
Support for faculty research at predominantly undergraduate institutions would rise 5% to $44 million. Support for graduate students on research awards would rise 9% to $111 million, allowing support of an additional 445 graduate students, which brings the total to about 11,140. Support for graduate research fellowships, however, is set to remain constant at $27.3 million, whereas support for postdoctoral research will increase 7% to $61.2 million.

NSF is reorganizing its engineering directorate, it says, to achieve a better balance between established engineering disciplines and those just emerging and to create stronger links between academic engineering and industry. Overall proposed funding for the engineering directorate is up 13% to $170 million. Support for engineering research centers will rise 150% to $25 million. But funding for chemical, biochemical, and thermal engineering is being held constant at $29.3 million.

It appears that support for science and engineering education would be held constant at $82 million in fiscal 1986. However, NSF intends to spend only $51 million of the $82 million education budget this year, leaving $31 million available for spending in fiscal 1986. Thus, it will actually ask Congress for only $51 million in new spending authority for fiscal 1986.

The Department of Agriculture is one of the agencies contributing to the downside of R&D funding for fiscal 1986. Most of the more than $57 million drop in its total research proposal comes from the Cooperative State Research Service. The biggest change would be elimination of the special research grant category, which currently funds such things as animal drug clearance, pesticide impacts, germ plasm research, and acid precipitation. This program funded at $28.5 million in fiscal 1985 has been zeroed out in the Administration's proposal. Other cuts at CSRS include elimination of $5.8 million for research in livestock and poultry diseases at veterinary colleges, and about $5.8 million for competitive grants and higher education programs at state universities.

In 1986 the Agricultural Research Service would get about this year's funding, which the Administration says will allow for an additional $5.5 million for high-priority research projects. This is to become available from an equivalent amount of decreased spending




from "management savings and changes in pay scales," according to USDA estimates.

The ARS is the target of one of the many fiscal 1985 recission proposals being sent to Congress along with fiscal 1986 budget proposals. The Administration wants to take $37.9 million out of the current year's budget. Congress had appropriated the funds for planning, design, and construction of a number of new research laboratories which the Administration says aren't needed because ARS's research facility system has been operating well below its capacity for years.

The facilities the Administration doesn't want built include: south central small farms research center, national soil tilth center, germ plasm collection facility, metabolism and radiation research laboratory, south central agricultural research laboratory, plant stress and soil moisture laboratory, and the forage seed production and research center.

At the Forest Service, a cut of $15.8 million has been proposed for its in-house research, which USDA says will be spread throughout its programs. Even so, about 60 scientist positions will have to be eliminated.

Although it is pointed to as a shining example of the Administration's support for both research and the environment, the EPA R&D budget is still relatively small. With a proposed $19.4 million increase, the total R&D budget would become $325 million for fiscal 1986. According to the organization Environmental Safety, which has been a severe critic of the Reagan Administration's funding for EPA, this gives the R&D office less spending power than it had in 1972.

Still, the 6% proposed rise is a slight improvement. The greatest change is for research on toxic substances, which will get $11.8 million more for 1986, to be used to develop environment risk assessment methodologies and to initiate research in epidemiology and reproductive toxicology. EPA says it will try to gather new information in hopes of regulating, not banning, chemicals already being used.

Also, for the first time in a number of years, energy R&D at EPA is the largest area of research. This is directly attributable to a huge increase in acid rain research, funding for which would rise to $60.5 million from $22.9 million this year. The big-ticket energy research item in the past, synthetic fuels, is being phased out. Only some health effects work remains, and this will be completed in 1985.

A large cut in EPA's proposed research funding occurs in the interdisciplinary category. This is being accomplished by making about a $7.6 million decrease in funding for exploratory research grants and in the number of university-based centers of excellence. Other decreases are proposed for air, drinking water, radiation, and management. Most of these reductions are said to result from completion of regulatory projects for which funds are no longer needed.

Decimated may be the best way to describe the Department of Commerce's proposed research budget. It's down 30% to $271 million. The National Bureau of Standards' budget would decline 14% to $108 million. According to NBS director Ernest Ambler,

## Research at NASA up handsomely

| $ Millions | 1986[a] | 1985[a] | 1984[b] | % change 1985–86 |
|---|---|---|---|---|
| Conduct of R&D | $2670.7 | $2421.8 | $2077.1 | 10% |
| Physics and astronomy | 630.4 | 677.2 | 567.6 | −7 |
| Space applications | 551.8 | 374.1 | 314.0 | 48 |
| Space transportation systems | 459.3 | 351.4 | 431.7 | 31 |
| Planetary exploration | 359.0 | 290.9 | 217.4 | 23 |
| Aeronautical research | 354.0 | 342.4 | 315.3 | 3 |
| Space station | 230.0 | 150.0 | 21.9[c] | 53 |
| Space research & technology | 168.0 | 150.0 | 137.0 | 12 |
| Life sciences | 72.0 | 62.3 | 58.0 | 16 |
| Commercial use of space | 30.0 | 8.5[c] | — | 253 |
| Tracking & data acquisition | 16.2 | 14.8 | 14.2 | 9 |
| R&D facilities | 149.3 | 150.0 | 155.5 | 0 |
| TOTAL | $3020.0 | $2771.8 | $2232.6 | 17% |

a Estimate. b Actual. c Start-up funds originally from other categories. Source: National Aeronautics & Space Administration

## EPA's R&D funds continue to climb

| $ Millions | 1986[a] | 1985[a] | 1984[b] | % change 1985–86 |
|---|---|---|---|---|
| Energy/acid rain | $ 67.2 | $ 58.1 | $ 37.4 | 16% |
| Air | 65.4 | 67.1 | 57.9 | −3 |
| Hazardous wastes | 49.6 | 41.1 | 34.1 | 21 |
| Toxic substances | 37.7 | 25.9 | 23.0 | 46 |
| Water quality | 28.2 | 27.3 | 25.2 | 3 |
| Drinking water | 23.9 | 24.7 | 22.4 | −3 |
| Interdisciplinary | 18.7 | 26.4 | 22.6 | −29 |
| Superfund | 13.1 | 12.7 | 10.2 | 3 |
| Pesticides | 12.3 | 10.2 | 6.0 | 21 |
| Program management | 8.4 | 9.7 | 8.9 | −13 |
| Radiation | 0.2 | 2.1 | 1.7 | −90 |
| TOTAL | $324.7 | $305.3 | $249.4 | 6% |

a Estimate. b Actual. Note: Obligations. Source: Environmental Protection Agency

## Defense RDT&E again scores big gains

| $ Millions | 1986[a] | 1985[a] | 1984[b] | % change 1985–86 |
|---|---|---|---|---|
| Tactical programs | $12,395.2 | $ 9,493.2 | $ 7,929.3 | 31% |
| Strategic programs | 8,555.6 | 8,359.0 | 7,877.7 | 2 |
| Advanced technology development | 5,461.3 | 2,765.8 | 1,352.2 | 97 |
| Intelligence & communications | 5,031.1 | 3,956.6 | 3,406.0 | 27 |
| Defensewide mission support | 4,311.8 | 3,751.2 | 3,318.2 | 21 |
| Technology base | 3,525.1 | 3,121.0 | 3,055.1 | 13 |
| TOTAL | $39,280.1 | $31,451.8 | $26,938.5 | 25% |

a Estimate. b Actual. Source: Office of Management & Budget

## Agriculture is a big loser in 1986

| $ Millions | 1986[a] | 1985[a] | 1984[b] | % change 1985–86 |
|---|---|---|---|---|
| Agricultural Research Service | $487.3 | $487.7 | $469.0 | 0% |
| Cooperative State Research Service | 251.2 | 291.9 | 255.5 | −14 |
| Forest Service research | 104.2 | 120.0 | 109.4 | −13 |
| National Agricultural Library | 11.1 | 11.4 | 10.4 | −3 |
| TOTAL | $853.8 | $911.0 | $844.3 | −6% |

a Estimate. b Actual. Source: Department of Agriculture

## Research at DOE drops 6%

| $ Millions | 1986[a] | 1985[a] | 1984[b] | % change 1985–86 |
|---|---|---|---|---|
| Defense R&D, testing | $1868.2 | $1810.1 | $1386.1 | 3% |
| Energy supply R&D | 1669.6 | 1833.2 | 2059.9 | −9 |
| Supporting research and technical analysis | 426.6 | 446.9 | 342.4 | −4 |
| Magnetic fusion | 390.0 | 434.0 | 469.1 | −10 |
| Nuclear fusion | 371.8 | 416.3 | 697.7 | −11 |
| Environment | 228.3 | 230.9 | 229.4 | −1 |
| Solar and other renewables | 175.6 | 211.8 | 218.8 | −17 |
| Other | 77.3 | 93.3 | 102.5 | −17 |
| General science and research | 885.4 | 728.3 | 634.6 | −6 |
| Fossil R&D | 242.7 | 347.1 | 342.4 | −30 |
| Conservation R&D | 145.1 | 176.0 | 176.8 | −18 |
| TOTAL | $4811.0 | $4894.7 | $4593.6 | −6% |

a Estimates. b Actual. Sources: Department of Energy, Office of Management & Budget

## NIH funding drops for first time

| $ Millions | 1986[a] | 1985[a] | 1984[b] | % change 1985–86 |
|---|---|---|---|---|
| National Institutes | $4474.4 | $4717.9 | $4022.3 | −5% |
| Cancer | 1126.0 | $1183.6 | 1061.6 | −5 |
| Heart, Lung & Blood | 775.2 | 805.3 | 704.9 | −4 |
| Arthritis, Diabetes & Digestive & Kidney Diseases | 519.9 | 543.6 | 464.0 | −4 |
| General Medical Sciences | 458.5 | 482.3 | 415.9 | −5 |
| Neurological & Communicative Disorders & Stroke | 373.9 | 396.9 | 335.9 | −6 |
| Allergy & Infectious Diseases | 352.6 | 371.0 | 319.6 | −5 |
| Child Health & Human Development | 293.1 | 313.3 | 276.0 | −6 |
| Environmental Health Sciences | 182.6 | 194.8 | 180.6 | −6 |
| Eye | 164.4 | 181.7 | 155.1 | −10 |
| Aging | 134.5 | 144.5 | 115.3 | −7 |
| Dental research | 93.4 | 100.7 | 88.7 | −7 |
| Research resources | 263.0 | 304.0 | 243.2 | −13 |
| National Library of Medicine | 53.3 | 55.9 | 49.6 | −5 |
| Research facilities | 14.9 | 21.7 | 25.0 | −31 |
| John E. Fogarty Center | 11.4 | 11.7 | 11.3 | −3 |
| TOTAL | $4817.0 | $5111.2 | $4351.4 | −6% |

a Estimate. b Actual. Source: Office of Management & Budget

## NSF budget would be up 7% . . .

| $ Millions | 1986[a] | 1985[a] | 1984[b] | % change 1985–86 |
|---|---|---|---|---|
| Mathematical and physical sciences | $ 428.9 | $ 396.6 | $ 355.0 | 8% |
| Astronomical, atmospheric, earth, and ocean sciences | 372.2 | 351.7 | 326.6 | 6 |
| Biological, behavioral, and social sciences | 272.0 | 252.0 | 223.4 | 8 |
| Engineering | 170.1 | 150.0 | 128.6 | 13 |
| Antarctic program | 120.1 | 110.8 | 102.4 | 8 |
| Science and engineering education | 82.0 | 82.0 | 57.1 | 0 |
| Program development and management | 69.9 | 70.7 | 66.2 | −1 |
| Advanced scientific computing | 46.2 | 41.5 | 6.0 | 11 |
| Scientific, technological, and international affairs | 38.4 | 44.5 | 38.2 | −14 |
| Special foreign currency | 1.0 | 2.8 | 2.9 | −64 |
| TOTAL | $1600.8 | $1502.8 | $1308.7 | 7% |

a Estimate. b Actual. Note: Obligations. Source: National Science Foundation

"This proposed budget is the result of the Administration's careful evaluation of the bureau's programs and priorities. It reflects the minimum resources we need."

But even this minimal budget allows for some increases. For example, NBS would get $8 million for a cold neutron source facility for measuring the properties, performance, and processing of high-technology materials. Other proposed funds include $3.5 million for development of key measurements and data pertaining to the use and manufacture of advanced ceramics, $3.0 million for development of measurements and standards for biotechnology, and $1.9 million for process and quality control measurements.

However, if there are increases, there must be decreases in a budget that is down overall. Once again the Administration is calling for elimination of the Center for Building Technology and the Center for Fire Research for savings of $8.2 million. The automated data standards development and testing program would be cut in half to $5 million, and $3.3 million comes out of NBS's equipment replacement program.

For Commerce's other major research agency, the National Oceanic & Atmospheric Administration, the budget will be cut sharply. Not only would NOAA's operations, research, and facilities budget be down 20% to $933 million in fiscal 1986, it may also lose some of its fiscal 1985 funding as well.

The Administration is requesting a recission of $104 million in the current budget that already has been approved by Congress. It wants to eliminate the Sea Grant program ($19.5 million), ocean service centers ($4.9 million), the second polar satellite ($38.8 million), and coastal zone management grants ($37 million).

If Congress doesn't approve the recission in the fiscal 1985 budget, the Administration will try to eliminate these programs again in the fiscal 1986 budget. It wants to cut NOAA's ocean and coastal programs budget 57% to $92 million. Also scheduled for elimination are the underseas research program and the Great Lakes environmental research laboratory.

The Tennessee Valley Authority is not one of the largest supporters of federal R&D projects, but it is very big in fertilizer development. Its national fertilizer development center in Muscle Shoals, Ala., is active in both fertilizer R&D and introduction. That may no longer be the case in the near future. The fiscal 1986 budget proposal calls for cutting the budget for these activities 85% to $10 million.

Of course, Congress has yet to work its will on the proposed budget. The Administration has the first but not the last say on what will be spent in any fiscal year. The pattern in the past few years, with the exception of the DOD research budget—which usually gets trimmed—has been for Congress to accept the Administration's budget proposals for increases in R&D funding, and to beef up funding for items in which large cuts have been proposed. That pattern may not hold true this year, when everyone is expressing deep concern about the federal deficit. □

# Chemical Earnings Slipped in Fourth Quarter

William J. Storck, C&EN New York

The economic recovery ended for the U.S. chemical industry in the fourth quarter of 1984 after lasting essentially about a year and a half. Sales for the industry were unchanged from fourth-quarter 1983, and earnings fell 6%. This caused profit margins to slip to their lowest levels in more than 12 months—a performance picture that carried through to the oil companies and to many diversified firms producing chemicals. The question now is whether the chemical industry will remain soft, or find some spark to kindle new growth.

Another sign that the industry is slowing is the number of companies with falling earnings. In the third quarter, in which earnings increased an average of 14% for 30 basic chemical firms surveyed by C&EN, seven companies had declining earnings and all of them registered higher sales. But in the fourth quarter, the number of companies with declining income almost doubled to 13 (out of a sample of 28 reporting at press time) and eight firms had lower sales.

By this time in the chemical recovery many of the cost-cutting measures, such as employment reductions and streamlining of plants instituted by the industry, have been exploited to their limits. And now costs are rising. Prices, which normally would offset the increased costs, are not keeping pace, and production is becoming stagnant. In the fourth quarter, according to government data, prices for chemicals and allied products averaged only 1.6% above the same period in 1983, and production chalked up its lowest annual increase—about 2.4%—since

## Chemical industry leaders for fourth-quarter. . .

**Sales**

| Rank | $ Millions | Rank 1983 |
|---|---|---|
| 1 Dow Chemical | $2687.0 | 1 |
| 2 Union Carbide | 2380.0 | 2 |
| 3 W. R. Grace | 1830.8 | 3 |
| 4 Monsanto | 1559.0 | 4 |
| 5 PPG Industries | 1057.0 | 5 |
| 6 American Cyanamid | 976.0 | 6 |
| 7 Celanese | 825.0 | 7 |
| 8 Hercules | 617.4 | 8 |
| 9 National Distillers | 582.2 | 9 |
| 10 Olin | 496.0 | 10 |

**Earnings[a]**

| | $ Millions | Rank 1983 |
|---|---|---|
| 1 PPG Industries | $80.4 | 3 |
| 2 Dow Chemical | 64.0 | 1 |
| 3 W. R. Grace | 59.1 | 5 |
| 4 Union Carbide | 57.8 | 4 |
| 5 American Cyanamid | 50.8 | 6 |
| 6 Hercules | 44.1 | 11 |
| 7 Monsanto | 41.0 | 2 |
| 8 Ethyl | 38.5 | 9 |
| 9 Air Products | 32.1 | 8 |
| 10 Celanese | 32.0 | 7 |

**Profitability**

| | Earnings as % of sales | Rank 1983 |
|---|---|---|
| 1 Freeport-McMoRan | 12.8% | 2 |
| 2 International Flavors | 12.0 | 1 |
| 3 Nalco Chemical | 10.3 | 4 |
| 4 Ethyl | 9.9 | 6 |
| 5 Loctite | 9.4 | 3 |
| 6 Petrolite | 9.4 | 8 |
| 7 PPG Industries | 7.6 | 7 |
| 8 Air Products | 7.4 | 5 |
| 9 First Mississippi | 7.3 | 22 |
| 10 Hercules | 7.1 | 18 |

## . . . and for full-year 1984

**Sales**

| Rank | $ Millions | Rank 1983 |
|---|---|---|
| 1 Dow Chemical | $11,418.0 | 1 |
| 2 Union Carbide | 9,500.0 | 2 |
| 3 W. R. Grace | 6,727.8 | 4 |
| 4 Monsanto | 6,691.0 | 3 |
| 5 PPG Industries | 4,200.0 | 5 |
| 6 American Cyanamid | 3,856.7 | 6 |
| 7 Celanese | 3,328.0 | 7 |
| 8 Hercules | 2,571.0 | 8 |
| 9 National Distillers | 2,244.9 | 9 |
| 10 Olin | 2,065.3 | 10 |

**Earnings[a]**

| | $ Millions | Rank 1983 |
|---|---|---|
| 1 Dow Chemical | $549.0 | 2 |
| 2 Monsanto | 439.0 | 1 |
| 3 Union Carbide | 374.7 | 3 |
| 4 PPG Industries | 317.3 | 4 |
| 5 American Cyanamid | 215.9 | 5 |
| 6 Hercules | 197.2 | 6 |
| 7 W. R. Grace | 192.6 | 7 |
| 8 Rohm & Haas | 172.2 | 8 |
| 9 Celanese | 161.0 | 10 |
| 10 Air Products | 138.6 | 9 |

**Profitability**

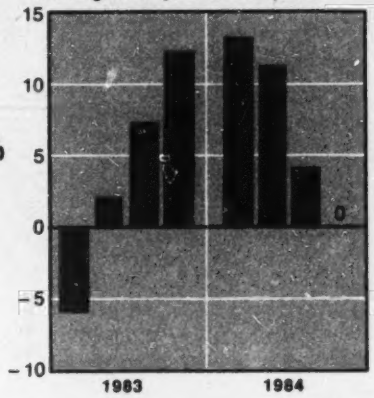
| | Earnings as % of sales | Rank 1983 |
|---|---|---|
| 1 International Flavors | 14.5 | 1 |
| 2 Freeport-McMoRan | 11.7 | 2 |
| 3 Nalco Chemical | 11.0 | 3 |
| 4 Loctite | 10.6 | 4 |
| 5 Petrolite | 8.8 | 6 |
| 6 Rohm & Haas | 8.4 | 7 |
| 7 Air Products | 7.9 | 8 |
| 7 Ethyl | 7.9 | 12 |
| 9 Hercules | 7.7 | 13 |
| 10 PPG Industries | 7.6 | 9 |

a After taxes. **Note:** Based on 30 companies listed on page 20.

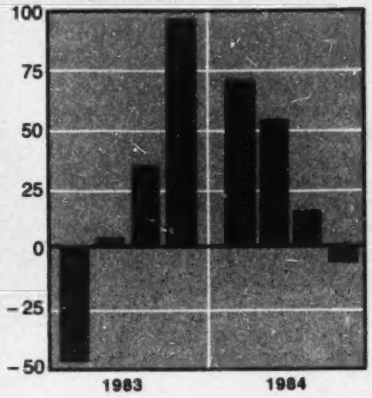
# Chemical industry 1984 fourth-quarter results

- Sales were flat
- Earnings declined 6%
- Profit margins fell to 4.2%
- Production rose only 2%
- Prices were up 2%

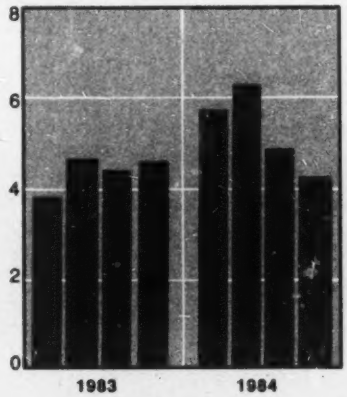
**Sales**
% change from year-earlier quarter



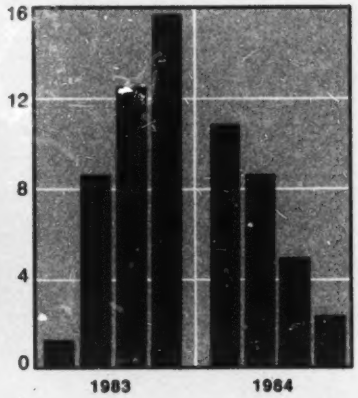

**Earnings**
% change from year-earlier quarter



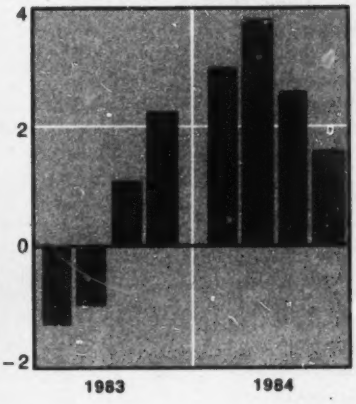

**Profit margins**
After-tax earnings as % of sales




**Production**
% change from year-earlier quarter

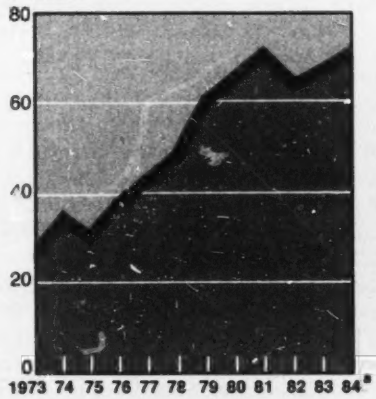



**Prices**
% change from year-earlier quarter

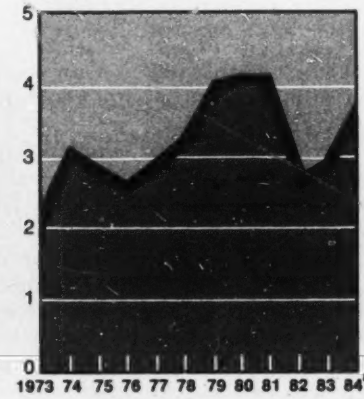



## Sales for 1984 were up 7%, and earnings climbed 29% to raise profitability to 5.3%

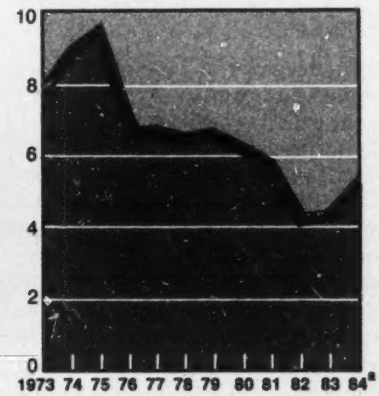
**Annual sales**
$ Billions




**Annual earnings**
$ Billions




**Annual profit margins**
After-tax earnings as % of sales




a Preliminary. **Note:** All sales, earnings, and profit-margin data are based on the combined results of the 30 companies listed on page 20.

## Average earnings for largest chemical companies fell 9% in fourth quarter

| | FOURTH-QUARTER 1984 | | | | | | FULL-YEAR 1984 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sales ($ millions) | Earnings[a] ($ millions) | Change from 1983 Sales | Change from 1983 Earnings[a] | Profit margin[b] 1984 | Profit margin[b] 1983 | Sales ($ millions) | Earnings[a] ($ millions) | Change from 1983 Sales | Change from 1983 Earnings[a] | Profit margin[b] 1984 | Profit margin[b] 1983 |
| Air Products | $ 435.5 | $ 32.1 | 5% | −5% | 7.4% | 8.2% | $ 1,754.7 | $ 138.6 | 6% | 21% | 7.9% | 6.9% |
| American Cyanamid | 976.0 | 50.6 | 6 | −6 | 5.2 | 6.0 | 3,858.7 | 215.9 | 9 | 30 | 5.6 | 4.7 |
| Celanese | 625.0 | 32.0 | −3 | −38 | 5.9 | 8.1 | 3,328.0 | 161.0 | 2 | 44 | 4.8 | 3.4 |
| Chemed | 89.9 | 3.5 | 15 | −14 | 3.9 | 5.1 | 346.1 | 20.1 | 28 | 16 | 5.8 | 6.4 |
| Crompton & Knowles | 52.8 | 2.0 | −11 | 15 | 3.8 | 2.9 | 230.4 | 7.9 | 0 | 25 | 3.4 | 2.7 |
| Dow Chemical | 2,687.0 | 64.0 | −8 | −23 | 2.4 | 2.9 | 11,418.0 | 549.0 | 4 | 87 | 4.8 | 2.7 |
| Essex Chemical | na | na | na | na | na | 0.2 | na | na | na | na | na | 1.9 |
| Ethyl | 387.2 | 38.5 | −14 | 19 | 9.9 | 7.2 | 1,675.1 | 132.2 | −4 | 25 | 7.9 | 6.1 |
| First Mississippi | 64.3 | 4.7 | 18 | 149 | 7.3 | 3.5 | 288.1 | 7.1 | 29 | 87 | 2.5 | 1.7 |
| Freeport-McMoRan | 216.3 | 27.6 | 8 | 21 | 12.8 | 11.4 | 842.2 | 98.4 | 7 | 9 | 11.7 | 11.5 |
| H. B. Fuller | 111.6 | 3.6 | 4 | −18 | 3.1 | 3.8 | 448.0 | 13.0 | 6 | −4 | 2.9 | 3.3 |
| W. R. Grace | 1,830.8 | 59.1 | 4 | 2 | 3.2 | 3.3 | 6,727.8 | 192.6 | 8 | 34 | 2.9 | 2.3 |
| Hercules | 617.4 | 44.1 | −3 | 61 | 7.1 | 4.3 | 2,571.0 | 197.2 | −2 | 31 | 7.7 | 5.7 |
| International Flavors | 103.8 | 12.4 | 6 | 6 | 12.0 | 11.9 | 476.7 | 69.2 | 3 | 1 | 14.5 | 14.8 |
| International Minerals | 377.2 | 20.5 | 7 | −5 | 5.4 | 6.1 | 1,607.0 | 96.0 | 8 | 13 | 6.0 | 5.7 |
| Loctite | 58.3 | 5.5 | 3 | −8 | 9.4 | 10.6 | 243.8 | 25.6 | 7 | 16 | 10.6 | 9.7 |
| Lubrizol | na | na | na | na | na | 6.4 | na | na | na | na | na | 8.2 |
| Monsanto | 1,559.0 | 41.0 | −6 | −47 | 2.6 | 4.7 | 6,691.0 | 439.0 | 6 | 13 | 6.6 | 6.2 |
| Morton-Thiokol | 449.6 | 29.4 | 11 | 23 | 6.5 | 5.9 | 1,953.4 | 114.4 | 14 | 23 | 5.9 | 5.4 |
| Nalco Chemical | 166.5 | 17.1 | 6 | 7 | 10.3 | 10.2 | 664.3 | 73.1 | 8 | 12 | 11.0 | 10.7 |
| National Distillers | 582.2 | 11.7 | 5 | −54 | 2.0 | 4.6 | 2,244.9 | 69.9 | 15 | 11 | 3.1 | 3.2 |
| Olin | 496.0 | 12.2 | 2 | 0 | 2.5 | 2.5 | 2,065.3 | 88.7 | 7 | 24 | 4.3 | 3.7 |
| Pennwalt | 259.0 | 16.8 | 6 | def | 6.5 | def | 1,047.2 | 50.4 | 7 | 118 | 4.8 | 2.4 |
| Petrolite | 75.3 | 7.1 | −5 | 46 | 9.4 | 6.8 | 294.1 | 25.8 | 2 | 17 | 8.8 | 7.7 |
| PPG Industries | 1,057.0 | 80.4 | 10 | 18 | 7.6 | 7.0 | 4,200.0 | 317.3 | 14 | 30 | 7.6 | 6.6 |
| Reichhold Chemicals | 177.1 | 5.9 | −1 | 9 | 3.3 | 3.0 | 801.4 | 25.7 | 7 | 18 | 3.2 | 2.9 |
| Rohm & Haas | 454.5 | 25.2 | 5 | −12 | 5.5 | 6.6 | 2,042.0 | 172.2 | 9 | 25 | 8.4 | 7.3 |
| Stauffer Chemical | 327.6 | −3.2 | −13 | def | def | 4.3 | 1,448.3 | −0.5 | 10 | def | def | def |
| Union Carbide | 2,380.0 | 57.8 | 1 | −2 | 2.4 | 2.5 | 9,500.0 | 374.7 | 6 | 50 | 3.9 | 2.8 |
| Witco Chemical | 371.7 | 14.5 | 3 | −4 | 3.9 | 4.2 | 1,495.8 | 58.7 | 8 | 13 | 3.9 | 3.8 |
| **Total 15 largest firms** | **$15,114.3** | **$568.8** | **0%** | **−9%** | **4.0%** | **4.4%** | **$61,634.9** | **$3,258.7** | **6%** | **35%** | **5.3%** | **4.2%** |
| **Total next 13 firms** | **$ 2,074.3** | **$117.5** | **1%** | **11%** | **5.7%** | **5.2%** | **$ 8,626.4** | **$ 474.7** | **9%** | **24%** | **5.5%** | **4.8%** |
| **GRAND TOTAL** | **$17,188.6** | **$716.3** | **0%** | **−6%** | **4.2%** | **4.4%** | **$70,261.3** | **$3,733.4** | **7%** | **33%** | **5.3%** | **4.3%** |

a Earnings from continuing operations excluding major nonrecurring and extraordinary items. b Earnings as a percentage of sales. na = not available at press time. def = deficit.

the first quarter of 1983 as demand softened and companies worked off inventories.

Dow president and chief executive officer Paul F. Oreffice comments, "We did not see a normal seasonal increase in demand for chemical products during the fourth quarter. Therefore, we felt it was necessary to reduce inventories through lower operating rates." Du Pont's chairman Edward G. Jefferson states, "Fourth-quarter results were lower than anticipated, primarily because of some weakness in the industrial sector of the economy, which resulted in lower demand and price erosion for many of our industrial and specialty businesses."

One of the major problems for production—and pricing for that matter—has been foreign trade. The strength of the dollar against foreign currencies has been making U.S. exports expensive in relation to foreign goods, holding down exports. And the reverse situation has increased imports of chemicals into the U.S., enabling them to compete effectively with U.S.-produced chemicals.

According to government figures, chemical exports in the fourth quarter increased 9% over the same period the year before. But imports rose almost twice as fast, jumping nearly 18% during the final three months of the year. This drove down the chemical trade surplus in the fourth quarter, which dropped 4% from fourth-quarter 1983.

This isn't the whole story. Downstream products and goods that use chemicals are feeling the same pressure, if not more, from imports simply because it is more cost effective to ship higher-value-added finished products than bulk commodities.

Du Pont's Jefferson, though speaking of the full year in which the

company showed increased earnings, says, "Despite the improvement, many businesses continued to experience the adverse effects of the overvalued dollar, which has constrained volume and caused some price erosion in both domestic and international markets. Particularly hard hit was the domestic apparel fibers market, where 1984 imports of textiles and apparel increased about 34% over the 1983 level."

The result was something of a shocker for the industry. After a year-to-year doubling in the fourth quarter of 1983, annual quarterly increases in earnings for the industry have trended downward—70% in the first quarter, 52% in the second quarter, 14% in the third quarter, and now 6% in the fourth quarter.

In last year's fourth quarter, earnings for the 28 chemical companies that had reported by press time totaled $716 million, down an average of 6% from the same period of 1983, for the poorest growth performance since the first three months of 1983. Sales for the 28 were essentially unchanged at $17.2 billion, which is again the worst performance since the first quarter of the year before.

As a result, profit margins fell to an average of 4.2% in the final three months of 1984 from 4.4% in the same period of 1983. This is the lowest profit margin since first-quarter 1983, when it was 3.8%.

The smaller, more specialized firms in C&EN's survey lagged the larger companies in responding to the economy; this is becoming the norm. The 15 larger firms recorded an average earnings decline of 9% to a total of $599 million on flat sales of $15.1 billion. The 13 smaller companies that had reported, however, still managed an earnings gain of 11% to $118 million on a 1% sales gain to $2.07 billion. The result was that profit margins for the larger firms dropped to an average of 4.0% in the fourth quarter from 4.4% in the same period the year before. The average profit margin for the 13 smaller companies rose to 5.7% in the fourth quarter of 1984 from 5.2% a year earlier.

The weakness that became apparent in the fourth quarter actually began to surface in the previous three-month period. In the normally slow third quarter, earnings fell 27% from the second quarter, and sales were off 6%. This trend continued in the fourth quarter, with earnings dropping another 14% and sales falling 1%. Thus, unless something happens to renew growth in the industry, the second quarter of 1984 will have been the high point of the chemical recovery.

This quarter also was the high point in terms of profitability for many chemical firms, with profit margins for the 28 companies dropping to an average of 4.2% in the fourth quarter from 4.8% in the third quarter, 6.2% in the second quarter.

Again, the larger firms performed worse than the smaller ones. The drop in earnings from the third to the fourth quarter amounted to 16% for the 15 larger firms, and only 5% for the 13 medium-size companies. However, in sales, the 15 larger companies showed essentially no change between the third and fourth quarters, whereas sales at the 13 smaller firms dropped 4%. Thus, profit margins for the top 15 chemical companies dropped to 4.0% in the fourth quarter from 4.4% in the third; profit margins for the other 13 fell to 5.7% from 6.4%.

For the full year, earnings for the 28 companies increased 33% from 1983 to $3.73 billion on a sales increase of 7% to $70.3 billion. The 15 larger companies had an average earnings increase of 35% to $3.26 billion and a 6% sales increase to $61.6 billion. Earnings for the smaller companies grew less at 24% to $475 million; sales increased 9% to $8.63 billion.

As a result, profit margins for the larger firms rose faster than did those for the medium-sized companies. Profit margins for the 15 larger firms increased to an average of 5.3% in 1984 from 4.2% during the year before. Those for the smaller companies climbed to 5.5% from an average of 4.8% in 1983.

Because of the better profit picture for the full 12 months, company officials appear more eager to boast about the year than about the fourth quarter, especially since many firms set earnings records in 1984.

At Reichhold Chemicals, chairman and chief executive officer C. Robert Powell says, "We are pleased with the company's performance in 1984. We strengthened our balance sheet, improved our profitability, and continued to make progress toward our goal of 20% return on stockholders equity by the end of 1987."

Vincent L. Gregory Jr., chairman of Rohm & Haas, remarks, "We are very pleased and proud to report our outstanding financial results for 1984. The 1984 performance, coupled with the strong earnings gain in 1983, enabled us to double our earnings in two years. In addition, our return on equity of 18.4% is the highest for the company in over 25 years."

One group that chemicals both helped and hurt in the fourth quarter was the oil companies. In large part, oil company profits were down in the quarter because of softness in the world oil market. In some

### Ground rules for C&EN earnings analysis

C&EN's quarterly report on financial performance of the U.S. chemical industry contains data from the 30 largest U.S. basic chemical companies and from 36 oil and diversified companies, each with more than $200 million in annual chemical sales.

To be included in the table of basic chemical producers, a company must have at least 40% of its sales in chemicals, and its chemical operations must be the largest single portion of the company's operations.

In referring to chemical sales, C&EN means those chemicals whose molecular composition has been changed in the course of manufacture. Hence, chemical sales include those of traditional categories of basic petrochemicals and inorganics, organic intermediates and inorganic compounds, polymers such as plastics and fibers, agricultural chemicals, and specialty derivatives.

In listing earnings, the survey gives after-tax income for continuing operations before nonrecurring items and extraordinary charges. Foreign currency translations are included.

## Energy company earnings generally fell in fourth quarter, but those for diversified firms rose

| | % chemical sales | FOURTH-QUARTER 1984 Sales ($ millions) | Earnings[a] | Change from 1983 Sales | Earnings | Profit margin[b] 1984 | 1983 | FULL-YEAR 1984 Sales ($ millions) | Earnings[a] | Change from 1983 Sales | Earnings | Profit margin[b] 1984 | 1983 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **OIL AND GAS COMPANIES** | | | | | | | | | | | | | |
| American Petrofina | 15% | $ 531.3 | $ 17.3 | 5% | −26% | 3.2% | 4.6% | $ 2,145.2 | $ 45.1 | 3% | −18% | 2.1% | 2.6% |
| Atlantic Richfield | 10 | 6,004.0 | 285.0 | −7 | −32 | 4.7 | 6.5 | 24,654.0 | 832.0 | −1 | −46 | 3.4 | 6.2 |
| Chevron | 4 | 7,000.0 | 275.0 | −5 | −21 | 3.9 | 4.7 | 29,200.0 | 1,379.0 | 0 | −11 | 4.7 | 5.3 |
| Diamond Shamrock | 23 | 1,080.2 | 56.8 | −8 | def | 5.3 | def | 4,483.2 | 242.2 | 11 | def | 5.4 | def |
| Exxon | 7 | 24,545.0 | 1249.0 | −1 | 27 | 5.1 | 4.0 | 94,734.0 | 4,365.0 | −3 | −11 | 4.6 | 5.1 |
| Mobil | 4 | 15,600.0 | 286.0 | −3 | −36 | 1.8 | 2.8 | 60,600.0 | 1,037.0 | 3 | −31 | 1.7 | 2.5 |
| Phillips Petroleum | 16 | 4,010.0 | 193.0 | −2 | −5 | 4.8 | 5.0 | 15,760.0 | 791.0 | 2 | 24 | 5.0 | 4.1 |
| Shell Oil | 14 | 5,272.0 | 581.0 | 1 | 8 | 11.0 | 10.5 | 20,898.0 | 1,772.0 | 5 | 9 | 8.5 | 8.2 |
| Standard Oil (Ohio) | 5 | 3,207.0 | 340.0 | 1 | −22 | 10.6 | 13.7 | 12,251.0 | 1,486.0 | 2 | −2 | 12.1 | 12.6 |
| Sun Co. | 3 | 3,810.0 | 136.0 | −10 | −6 | 3.6 | 3.4 | 15,400.0 | 538.0 | −1 | 3 | 3.5 | 3.4 |
| Tenneco | 7 | 3,844.0 | 130.0 | 0 | −48 | 3.4 | 6.3 | 14,890.0 | 631.0 | 3 | −12 | 4.2 | 5.0 |
| Texaco | 4 | 19,002.0 | 213.0 | 69 | −17 | 1.1 | 2.3 | 48,100.0 | 1,071.0 | 17 | −13 | 2.2 | 3.0 |
| Unocal (Union Oil) | 11 | 2,970.0 | 153.4 | 11 | −14 | 5.2 | 6.6 | 11,540.0 | 700.4 | 8 | 12 | 6.1 | 5.9 |
| **DIVERSIFIED MANUFACTURERS** | | | | | | | | | | | | | |
| Allied | 22 | 2,608.0 | 98.0 | 6 | −17 | 3.8 | 4.8 | 10,734.0 | 487.0 | 8 | 9 | 4.5 | 4.5 |
| Aluminum Co. of America | 11 | 1,386.0 | −14.7 | −6 | def | def | 6.6 | 5,750.8 | 256.0 | 9 | 58 | 4.5 | 3.1 |
| Beatrice Foods | 5 | 3,748.0 | 127.0 | 53 | −7 | 3.4 | 5.6 | 11,427.0 | 433.0 | 22 | 14 | 3.8 | 4.1 |
| Borden | 18 | 1,145.3 | 52.6 | −2 | 0 | 4.6 | 4.5 | 4,568.0 | 191.4 | 7 | 1 | 4.2 | 4.4 |
| Borg-Warner | 24 | 984.1 | 56.6 | 3 | −1 | 5.8 | 6.0 | 3,915.6 | 206.1 | 11 | 13 | 5.3 | 5.2 |
| Du Pont | 32 | 6,837.0 | 306.0 | −3 | −10 | 3.5 | 3.8 | 35,915.0 | 1,431.0 | 2 | 27 | 4.0 | 3.2 |
| Eastman Kodak | 23 | 2,754.0 | 204.0 | 7 | 74 | 7.4 | 4.5 | 10,600.0 | 923.0 | 4 | 63 | 8.7 | 5.6 |
| Englehard | 13 | 642.3 | 20.2 | 36 | 0 | 3.1 | 4.3 | 2,511.0 | 74.6 | 20 | 1 | 3.0 | 3.5 |
| FMC | 37 | 868.8 | 49.4 | −3 | −19 | 5.7 | 6.8 | 3,337.8 | 225.9 | 3 | 20 | 6.8 | 5.8 |
| General Electric | 17 | 7,980.0 | 552.0 | 7 | 13 | 6.2 | 7.8 | 27,950.2 | 2,280.0 | 4 | 13 | 8.2 | 7.6 |
| Georgia-Pacific | 11 | 1,766.0 | 63.0 | 15 | 142 | 3.6 | 1.7 | 6,682.0 | 253.0 | 11 | 237 | 3.8 | 1.2 |
| Kaiser Aluminum | 19 | 878.2 | −27.8 | 22 | def | def | 7.1 | 3,192.2 | 7.9 | 29 | def | 0.2 | def |
| Koppers | 34 | 479.8 | 10.6 | 8 | 26 | 2.2 | 1.9 | 1,816.6 | 47.9 | 17 | 146 | 2.6 | 1.3 |
| Eli Lilly | 24 | 777.9 | 117.8 | 3 | 2 | 15.1 | 15.3 | 3,109.2 | 490.2 | 2 | 7 | 15.8 | 15.1 |
| 3M | 15 | 1,879.0 | 174.0 | 7 | 7 | 9.3 | 9.3 | 7,705.0 | 740.0 | 9 | 66 | 9.6 | 9.3 |
| Martin Marietta | 6 | 1,118.2 | 33.3 | 22 | 4 | 3.0 | 3.5 | 3,920.4 | 176.0 | 21 | 9 | 4.5 | 5.0 |
| Merck | 19 | 961.9 | 115.6 | 12 | 10 | 12.0 | 12.3 | 3,559.7 | 493.0 | 10 | 9 | 13.6 | 13.9 |
| NL Industries | 33 | 354.4 | 6.7 | 7 | 392 | 1.9 | 0.4 | 1,360.1 | 18.1 | 0 | def | 1.3 | def |
| Northwest Industries | 24 | 486.4 | 22.4 | 10 | 387 | 4.6 | 1.0 | 1,882.1 | 77.5 | 17 | 962 | 4.1 | 0.5 |
| Pfizer | 11 | 966.3 | 129.3 | −1 | 6 | 13.4 | 12.3 | 3,854.5 | 507.9 | 3 | 14 | 13.2 | 11.9 |
| Tyler | 32 | 221.1 | 6.7 | 4 | 56 | 3.0 | 2.0 | 928.5 | 29.0 | 23 | 73 | 3.1 | 2.2 |
| U.S. Steel | 6 | 4,659.0 | −44.0 | −1 | def | def | def | 19,104.0 | 106.0 | 9 | def | 0.6 | def |
| Vulcan Materials | 29 | 254.5 | 13.2 | 10 | −27 | 5.2 | 7.8 | 982.9 | 74.2 | 20 | 37 | 7.5 | 6.6 |

a From continuing operations excluding nonrecurring and extraordinary items. b Earnings as a percentage of sales. def = deficit.

cases, however, their petrochemical operations improved over the generally dismal showings of the past couple of years. At Standard Oil (Ohio), for instance, chemical earnings increased to $10 million in the fourth quarter of 1984 from just $3 million in the same period the year before. For the year, the company's chemical earnings totaled $44 million, up from a $34 million loss in 1983. A statement from the company says, "Chemical results for the quarter and year reflect higher earnings in both industrial and agricultural chemicals businesses."

At Atlantic Richfield, chemical earnings increased to $9 million in the fourth quarter from $6 million in fourth-quarter 1983. For the full year, the company's chemical earnings totaled $148 million, up from just $39 million in 1983.

Shell Oil, Mobil, and Exxon, however, reported much better chemical results for the full year than they did for the fourth quarter. At Shell, fourth-quarter earnings from chemicals fell to $16 million from $24 million in the same period the

year before, although its earnings from chemicals for the year more than doubled to $132 million in 1984 from the previous year.

Mobil recorded a $19 million loss in its chemical operations in the fourth quarter, compared with a profit of $14 million in fourth-quarter 1983. For the full year, the company's chemical earnings were $37 million, up from $24 million in 1983. At Exxon, the largest chemical producer among the oil companies, chemical earnings for the quarter decreased to $86 million from $120 million. For the year, however, they were up, totaling $423 million, compared with $270 million the year before.

Only a few markets seemed to show improvement in the fourth quarter and even in these areas results were mixed. One of these was fertilizer. James R. Moffett, chairman and chief executive officer of Freeport-McMoRan, says, "The year ended with strong demand for our agricultural minerals products, and fourth-quarter results from that segment of our business were up 75% over the fourth quarter in 1983."

First Mississippi states that fertilizer pretax operating profits for the first half of its fiscal year (corresponding to the second half of the calendar year) were $7.2 million, up 108% from the same period the year before on increased prices and margins. International Minerals & Chemical also points to good fertilizer results in the quarter, but W. R. Grace notes weakness in its fertilizer operations.

A related area that did not seem to do well in the fourth quarter was pesticides. At Monsanto, where earnings from agricultural and nutritional products fell to $37 million from $77 million in the same period of 1983, president and chief executive officer Richard J. Mahoney says, "Roundup herbicide sales were hurt by adverse weather conditions in Europe in late summer and early fall."

Stauffer Chemical notes that the major factor contributing to decreases in its sales and earnings was a drop in both domestic and international agricultural pesticide sales.

As for 1985, industry executives hope to see better economic times, but there are concerns. Although many see a slowdown this year, PPG Industries chairman Vincent A. Sarni expects some pickup in the first six months. "In the first half of 1985," he says, "PPG expects to benefit from a faster rate of growth in North America and Europe than occurred in the latter half of 1984. For the year as a whole, some slowing in growth rate is projected for the North American economy. We do not anticipate a similar slowing in Europe."

Monsanto's Mahoney says, "Looking ahead, worldwide industrial and agricultural product markets look reasonably favorable, although the strength of the U.S. dollar and the possible effects of federal deficits on financial markets continue to be important areas of leverage."

Gregory at Rohm & Haas adds, "Our plans for 1985 assume a reduced rate of economic expansion and continued low inflation in the U.S. economy. Raw materials costs should be flat or slightly down. Our overall performance will depend on the economy for volume growth and our ability to pass on inflationary costs through price increases." □

*INTERNATIONAL BUSINESS*

# U.K. chemicals had strong performance in 1984

Last year was a good one for the British chemical industry, and, although 1985 is not expected to be so good, it still will bring growth to the industry. That is the encouraging message from the new president of the Chemical Industries Association in London, John K. Pitts, chairman and chief executive of Tioxide Group.

Preliminary statistics indicate that in 1984, British chemical production increased 7% over 1983, and is now a few percentage points ahead of the industry's previous record in 1979. Exports grew 12% and domestic sales 4%. Imports, on the other hand, increased 16% and now make up 39% of British chemical consumption. However, with the strong export performance, the chemical industry contributed $2.18 billion (at $1.15 to 1 pound sterling) to the British trade balance, Pitts notes with some pride. The manufacturing industry as a whole had a trade deficit of $1.61 billion.

According to Pitts, improvements in 1984 were fairly widespread but were especially strong in the petrochemical and polymers sector of the industry. How long that will continue, however, is open to question. That sector will face particular problems over the next two years as the products from the Middle East become a major part of the market. Middle East chemicals pressure, in turn, will continue to convince manufacturers to restructure away from commodities and toward specialty chemicals.

End-of-year employment in the chemical industry stood at 332,000 in Britain, and is expected to decline another 2000 this year. "Increases in earnings have largely been contained by improvements in productivity," says Pitts, "but wage costs per unit of output are now rising."

Confirming that prediction is the latest quarterly survey on chemical industry pay settlements in Britain, by Manpower Ltd., a temporary services company. Manpower's survey, by telephone, of leading employers in the industry indicates that the average rate of pay increase in chemical manufacturing this year will be 4 to 6%. Some 35% of chemical manufacturing employers expect the rate to be higher this year than in 1984, although the majority, 55%, expect no change in the rate of increase.

In addition, Manpower's results indicate—despite the Chemical Industries Association prediction of an overall employment decline—that 24% of chemical manufacturing employers are planning staff increases in the first quarter of this year, compared with only 21% of similar employers for the same time last year. Staff losses are projected by 6% of employers in the industry, down from the 10% who planned cuts at the start of 1984. □

# NOTE

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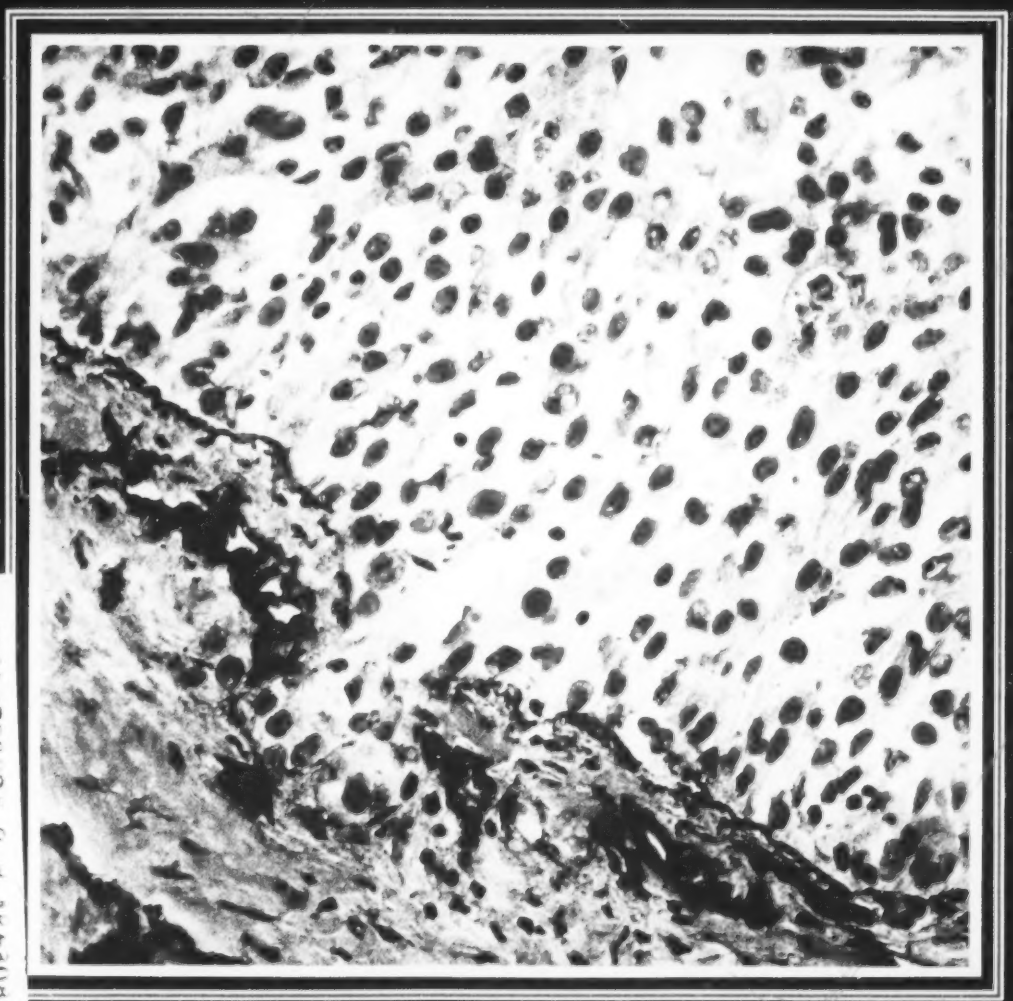
NEWS



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## News of the Week

■ **Chesebrough-Pond's acquires Stauffer Chemical.** **Page 6**

■ **EPA sets final regulations on reporting levels of accidental leaks for 340 chemicals.** **Page 7**

■ **Polymer fiber with high tensile strength ready for marketing.** **Page 7**

■ **National Institute for Chemical Studies will be set up in West Virginia's Kanawha Valley.** **Page 7**

■ **President Reagan re-emphasizes role of technological innovation in economic growth at National Medal of Technology awards.** **Page 8**

■ **OSHA concludes that the chance of an uncontrolled reaction of methyl isocyanate in U.S. is remote.** **Page 8**

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**Whether suits against Union Carbide** stemming from Bhopal will be tried in India or in U.S. is firm's next major hurdle. **Page 23**

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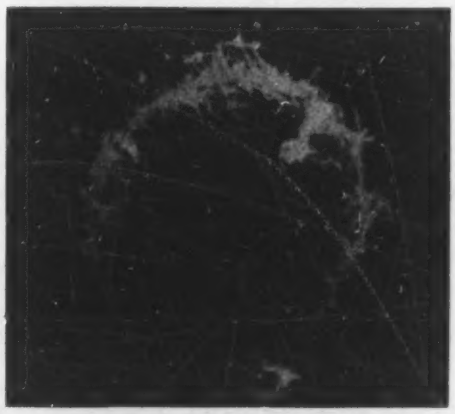
## ACS News

**New advisory board members have been selected** for the society's journals; most will serve three-year terms. **Page 34**

*Cover:* Metastatic cells (lower left, indicated by arrow) break off from human breast cancer tumor. Photo courtesy of Lance A. Liotta, National Cancer Institute



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# Global Outlook for Fertilizer Raw Materials: Cautious but Positive

**Even though growth rates will decline, shortages loom for raw materials unless producers begin preparing soon for capacity additions**

**Patricia L. Layman,** C&EN London

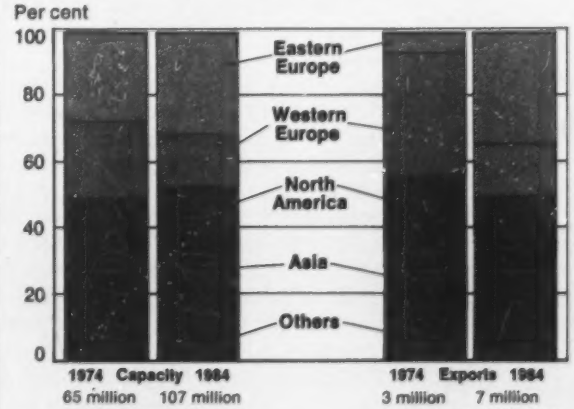
It was an international gathering, set to assess the international outlook for raw materials for the fertilizer industry over the next decade or so. Speakers at the conference, sponsored by British Sulphur Corp. and held in London earlier this month, picked out potential trouble spots for the industry's coming years. But they also reached the conclusion that, overall, the world outlook for fertilizer raw materials is cautious but positive.

That, in particular, was the message from Gino P. Giusti, president of Texasgulf Inc., of Stamford, Conn., who opened the conference with a broad overview of fertilizer raw materials to the year 2000. Giusti briefly traced the growth patterns of the industry over the past 20 years—total fertilizer consumption growth of an average 5.7% per year, with growth in all three of the basic nitrogen, phosphorus, and potassium (NPK) nutrients. Growth has been especially strong in areas other than the developed noncommunist countries (North America, Western Europe, Oceania, Israel, Japan, and South Africa), which accounted for about two thirds of the total fertilizer market in 1965 but now only about 39%. Communist countries—Eastern Europe, U.S.S.R., China, and other communist countries in Asia—account for 41% of the total now, up from 25% 20 years ago. And developing nations—Latin America, Africa (excluding South Africa), and noncommunist Asian countries (excluding Japan)—account for 20%, up from 9% in 1965.

Giusti expects NPK fertilizer consumption to reach about 211 million metric tons in the year 2000, up nearly 70% from the anticipated level of 125 million metric tons this fertilizer year. During the next 15 years, nitrogen fertilizer use likely will grow 13.5% per year, phosphorus 3.1% per year, and potassium 3.5%. These rates, if achieved, would be an improvement for nitrogen-containing fertilizers, up from an annual rate of 7.4% over the past 20 years, but a decline for phosphorus and potassium fertilizers, each down from an annual growth of 4.3% over that time.

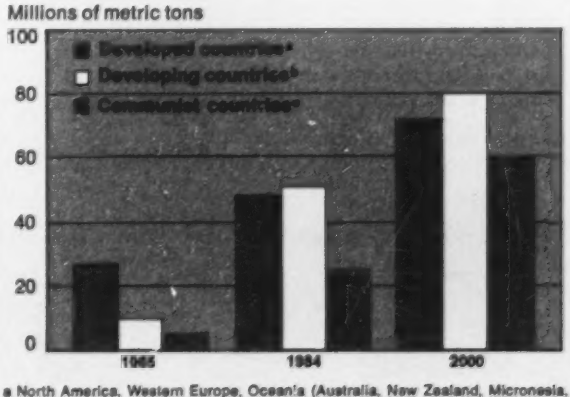
Consumption of fertilizers in the developed noncommunist countries is expected to grow at only 2.3% per year over the rest of the century, and that in communist countries, 2.9% per year. On the other hand, consumption of fertilizers in the developing countries will increase at nearly 6% per year to the year 2000, Giusti predicts, despite the strain placed on these countries by spending scarce money on fertilizers rather than on other necessities.

**North American share of ammonia capacity, exports has shrunk**




Source: Unie Van Kunstmestfabrieken B.V.

**Developing countries to remain biggest fertilizer user**




a North America, Western Europe, Oceania (Australia, New Zealand, Micronesia, Melanesia, Polynesia), Israel, Japan, and South Africa. b Latin America, Africa (excluding South Africa), and noncommunist Asia (excluding Japan). c Eastern Europe, U.S.S.R., and communist Asia. Source: Texasgulf

Even with declining growth rates, however, shortages loom for fertilizer raw materials, unless the industry begins preparing soon for capacity additions. The next major round of additions needs to occur in the early 1990s, Giusti says.

For example, effective nitrogen capacity, figured at 85% of nameplate capacity, probably will fall short of projected production requirements by about 1993. Even worse, the effective capacities for phosphate rock and potash will fail to meet production needs by about 1989, he forecasts. And the capacities themselves likely will begin to fall after 1990, when the U.S. industries begin to deplete their mines —after the Florida phosphate rock industry begins rapidly depleting its existing mines, and as potash mines are depleted.

Similarly, sulfur, a crucial ingredient for processing phosphate, will see constraints on availability. U.S. Frasch sulfur reserves are diminishing, Canadian stockpiles are being worked down, and existing sour-gas reserves are being depleted.

According to Giusti, Texasgulf estimates of capital requirements indicate that about 200 new world-scale fertilizer plants will be required by the year 2000. The cost of building the plants, in constant 1984 dollars, is estimated at about $66 billion. Moreover, refurbishing existing plants will require an additional $42 billion, making a total capital requirement of about $108 billion. Because of that staggering sum, Giusti adds, "I believe that future investment in new or expanded fertilizer production capacity will be more cautious."

Where the investments are made also will follow shifting trends, other speakers at the conference indicated. A case in point is sulfur. The sulfur industry already has survived one major revolution, as it changed from an industry once dominated by Frasch sulfur in the 1960s to one ever increasingly reliant on sulfur recovered from hydrocarbons. And the U.S. and Canada historically have been the primary producers and exporters of sulfur.

But as Jared E. Hazleton, of the Texas Research League in Austin pointed out, the U.S. Frasch sulfur industry has a bleak future. Identified and other reserves of Frasch minable sulfur were only 101 million metric tons, according to estimates at the end of 1983, significantly lower than adjusted 1970 estimates of 184 million metric tons. And production from Louisiana and Texas was 3.2 million metric tons in 1983, the lowest level of production since 1943. Production increased somewhat in 1984, Hazleton believes, probably topping 4 million metric tons. Nonetheless, the trend for U.S. Frasch sulfur is downward.

Similarly, Canadian sulfur production (in Alberta) has been "in a state of decline since 1973," according to David K. Arnott of Cansulex Ltd., industry consultants in Vancouver, B.C. Thanks to a massive stockpiling before 1979, Canada has seen sales of sulfur increase from 4.1 million metric tons in 1973 to nearly 8 million metric tons last year. However, the current inventory level is about 12 million metric tons, says Arnott, and the rate of removal last year was almost 3 million metric tons. As the rate of stockpile depletion accelerates, he predicts, the expected lifetime of the inventory is being reduced to the point where total depletion is expected by the end of the decade. Reserves are still large, both in present hydrocarbon production and also in the potential form of recovery from ultrahigh sour gas currently under R&D.

However, Canada will cease to be the dominant world producer of recovered sulfur by 1990, predicts Robert Boyd of British Sulphur Corp. in London. Western European countries as a group will be the single largest producing block, closely followed by the Soviet Union toward the end of the 1990s, as the Soviets recover sulfur from their Caspian Sea hydrocarbons. And by the end of the century, the Middle East also will be an important producing region, recovering sulfur from the natural gas that once was flared.

Poland will be the dominant producer of Frasch sulfur by 1987, Boyd adds. It has been producing at a relatively steady 5 million metric tons per year since the late 1970s, he says, and will continue to produce at that rate to obtain foreign currency through exports.

Eastern European countries have become the major exporter, too, of ammonia.

The U.S. is the third largest producer of nitrogen products, following the U.S.S.R. as leading producer (China is the second largest). And Middle Eastern producers are increasingly important world-trade suppliers, points out P. J. T. Samuels of Unie Van Kunstmestfabrieken of Utrecht, the Netherlands. The Soviet Union, the U.S., and the Arab countries all rely on natural gas as the raw material for ammonia production. Samuels predicts that will remain the favored starting material. □

**Shortage of fertilizer may develop by 2000**

| Millions of metric tons | Nitrogen | Phosphate rock | Phosphate ($P_2O_5$) | Potash ($K_2O$) | Total |
|---|---|---|---|---|---|
| World annual demand | 135.1 | 245.1 | 63.0 | 47.0 | 490.2 |
| Current annual capacity | 115.7 | 189.2 | 47.6 | 35.3 | 387.8 |
| Additional capacity required[a] | 43.2 | 99.2 | 26.5 | 20.0 | 186.9 |
| Number of new plants required | 75 | 25 | 76 | 23 | 199 |

a Based on 85% operating rate. Source: Texasgulf

**World potash consumption may grow 40% in next 10 years**

| Millions of metric tons of $K_2O$ | 1983–84 | 1988–89 | 1993–94 |
|---|---|---|---|
| Developed countries[a] | 12.17 (49%) | 13.81 (46%) | 15.08 (44%) |
| Developing countries | 3.27 (14%) | 4.48 (15%) | 5.64 (16%) |
| Communist countries | 9.25 (37%) | 11.55 (39%) | 13.85 (40%) |
| TOTAL | 24.69 (100%) | 29.84 (100%) | 34.57 (100%) |

a Noncommunist. Source: Kali & Salz A.G.

# Second Half Deflates Canadian Chemicals

1984 wasn't a particularly bad year for the Canadian chemical industry. But it wasn't a particularly good one, either. And it certainly would have been a lot better if it had ended at the midway mark.

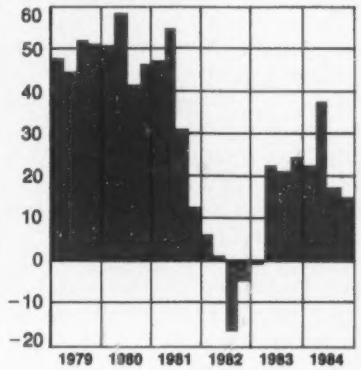
During the first six months of the year, sales were up substantially for most Canadian chemical companies. Earnings bounced back dramatically from the pits, where they'd been during all of 1982 and early 1983.

However, much of the gains that the Canadian chemical industry scored in the first half of 1984 were wiped out in the second half. The combined results of the four large, publicly reporting firms tracked by C&EN (C-I-L Inc., Celanese Canada, Du Pont Canada, and Union Carbide Canada) tell the story clearly.

During the first half of the year, the combined sales of these four companies increased 9% over first-half 1983. But in the second half, sales were 9% lower than they were in the first six months. The result: a modest and no doubt disappointing 3.9% increase in sales for the full year.

The second-half impact on their combined earnings was much more severe. Here's how those earnings progressed by quarter: The first quarter brought a $22.5 million (Canadian dollars throughout) profit compared with a $1.0 million loss in first-quarter 1983. In the second quarter, earnings were up 67%. But in the third and fourth quarters, earnings were down 16% and 39% from the corresponding 1983 quarters, respectively. As a result, earnings that were 183% higher than in 1983 at the halfway mark were only 38% better by the end of the year. Good, but also disappointing.

**Combined earnings taper off in second half**




a After-tax earnings of four largest publicly reporting Canadian chemical companies—C-I-L, Celanese Canada, Du Pont Canada, and Union Carbide Canada.

Most major Canadian chemical companies followed the good-first-half, poor-second-half pattern. Some had unfortunate losses from extraordinary expenses that ate into otherwise respectable 1984 earnings. And some fared much better than others.

Perhaps because it is a more diversified company, C-I-L increased its 1984 earnings over 1983 much more than its three other Big Four counterparts. Although C-I-L's sales were up only 5.6% to $1.18 billion last year, earnings, excluding extraordinary items, jumped a hefty 59% to $38 million.

But C-I-L's $38 million net income from operations has to be tempered by a $3 million extraordinary loss. This resulted from a $4.5 million loss attributable to plant closings coupled with a $1.5 million gain from the sale of Hanson, its electroplating chemical subsidiary.

The particular problems of other companies were more severe. For Celanese Canada, the problem was textiles. Union Carbide Canada's concern was petrochemicals.

Celanese enjoyed strong sales in its chemicals and industrial products group, even during the fourth quarter. But these were more than offset by lower sales volumes and margins in the textile group. Textiles probably will face tough sledding throughout the first half of 1985, Celanese says. The company wants the Canadian government to reduce the flow of imported garments into Canada from countries with low labor costs.

Improved performance in industrial gases and carbon products helped Union Carbide Canada to rack up earnings of $5.7 million last year, compared with a net loss of $1.4 million in 1983. But write-downs associated with the company's petrochemical operations resulted in a net loss of $28.2 million.

Carbide Canada's extraordinary loss included a nearly $31 million write-down of its investment in Petrosar, the petrochemical core company in Sarnia, Ont. Another $4.4 million was written off on its Montreal East polyethylene plant, which figured prominently in the recent troubles of Pétromont, the core petrochemical company in the Montreal area. Carbide Canada owns 50% of Pétromont, and the company's 1984 results reflect about $12 million in government aid given to Pétromont last year.

*Earl Anderson, New York*

**Sales were up, but earnings were mixed bag**

| | FULL-YEAR 1984 | | | | | |
|---|---|---|---|---|---|---|
| $ Millions (Canadian) | Net sales | Change from 1983 | Net income[a] | Change from 1983 | Profit margin[b] 1984 | 1983 |
| C-I-L Inc. | $1178.0 | 5.6% | $38.0 | 59.0% | 3.2% | 2.1% |
| Celanese Canada | 387.4 | 2.3 | 7.8 | −17.0 | 2.0 | 2.5 |
| Du Pont Canada | 1170.6 | 4.9 | 41.2 | 17.0 | 3.5 | 3.2 |
| Union Carbide Canada | 691.4 | 0.6 | 5.7 | c | 0.8 | c |
| TOTAL | $3425.4 | 3.9% | $92.7 | 38.2% | 2.0% | 2.7% |

a Net income from continuous operations, excluding extraordinary gains or losses. b Net income as percentage of sales. c Deficit in 1983.

proliferation as well as the other issues raised in the posture paper play in Congress this year. No matter what emotions they stir, they may become totally irrelevant if the Presidential chemical warfare review panel decides in favor of a small modernized—the codeword this year for binary—stockpile, a finding considered likely.

Another question mark is Rep. Aspin, now chairman of the House Armed Services Committee. Aspin consistently has voted against binary weapons. But he may decide to use the issue as a bargaining chip—the way he changed his vote on the MX missile—to prod the Administration to a chemical arms accord.

The Pentagon's request for binaries is expected to be turned down again. However, says one Congressional observer, "With Ed Bethune gone [as a Representative from Arkansas, he was a leading opponent of the binary], with Aspin and the Presidential panel question marks, and with the Administration pulling out all the stops, it's going to be a tough year for binary opponents." □

# EPA fares well among '86 regulatory budgets

Among the federal regulatory agencies, only one—the Environmental Protection Agency—fared well in the Administration's budget proposal for fiscal 1986 submitted earlier this month to Congress. Budgets for the other regulatory agencies that interact in one way or another with the chemical industry are either frozen at or cut from fiscal 1985 levels.

Hazardous waste gets top priority in EPA's budget proposal. Funding for the Superfund program, which finances evaluation and cleanup of abandoned hazardous waste sites, would increase 45% from this year's budget to $900 million. Funding for programs aiming to curb future hazardous waste problems is slated to rise 26% to $236 million.

In setting its 1986 Superfund budget targets, EPA is assuming that when Congress reauthorizes the law this year the taxes that finance Superfund will be set at a substantially higher level than they are now. And all of the financing will come out of industry's pockets. The Administration will not request a renewal of the annual government payment of $44 million that has been made to fund the program over the past five years.

Out of the $900 million budget, $760 million is earmarked primarily for remedial design and construction actions. Engineering designs for Superfund sites will increase from 64 in 1985 to 89 in 1986. Remedial constructions, the final and most expensive phase of the cleanup process, are expected to increase 124% to 56 in 1986. EPA also intends to begin planning work at an additional 130 sites, bringing the total of sites where planning has begun to 536 by the end of 1986.

Much of the $67 million increase slated for hazardous waste activities under the recently amended Resource Conservation & Recovery Act is expected to be used internally by EPA on developing and promulgating the more than 70 major regulations that are now required. These include banning waste from land disposal, identifying alternative treatment technologies and pretreatment standards for those banned wastes, and developing timely and effective regulations for small-quantity generators. In addition, $70 million will be allocated to the states for underground storage tank activities.

Turning to other regulatory agencies, proposed funding for the Food & Drug Administration is essentially frozen at $408 million, with a staff reduction of about 200 slated for 1986. Funding for the Justice Department's environmental enforcement activities also is being held constant at just over $22 million, as is funding for the antitrust division at $43 million.

The proposed budget for the Occupational Safety & Health Administration is 3% lower than in the current fiscal year, down to $213 million. Even with decreased funding, the agency says it can still support the same number of inspections in 1986 as it plans this year: 71,400; support the same number of state program inspections: 108,000; and visit the same number of workplaces for consultation: 25,600.

The Federal Trade Commission's efforts, as the budget document says, "to eliminate threats to fair and honest competition from all sources" will have to go forward with a 3% reduction in funding to $64 million. The Consumer Product Safety Commission's efforts to protect the public from hazardous products is scheduled to proceed with 6% less funding at $33.7 million.

*Janice Long, Washington*

**EPA's budget is up 11% . . .**

| $ Millions | 1986[a] | 1985[a] | 1984[b] |
|---|---|---|---|
| Superfund | $ 900.0 | $ 620.0 | $ 460.0 |
| Management and support | 283.6 | 293.4 | 251.9 |
| Water quality | 238.6 | 248.2 | 217.8 |
| Air | 236.1 | 235.8 | 222.6 |
| Hazardous waste | 235.8 | 186.6 | 129.4 |
| Toxic substances | 93.7 | 82.9 | 119.4 |
| Drinking water | 87.2 | 87.0 | 77.5 |
| Pesticides | 69.3 | 67.7 | 57.1 |
| Energy | 67.2 | 58.1 | 36.7 |
| Radiation | 9.6 | 11.9 | 11.3 |
| TOTAL | $2220.5 | $1991.6 | $1583.7 |

**. . . FDA's stays even . . .**

| $ Millions | 1986[a] | 1985[a] | 1984[b] |
|---|---|---|---|
| Drugs | $152.4 | $153.1 | $138.2 |
| Foods | 113.9 | 109.5 | 115.5 |
| Devices, radiological products | 68.4 | 67.1 | 62.6 |
| Program management | 50.6 | 58.2 | 50.2 |
| National Center for Toxicological Research | 22.3 | 21.6 | 21.1 |
| TOTAL | $407.6 | $409.5 | $387.6 |

**. . . but OSHA's is cut 3%**

| $ Millions | 1986[a] | 1985[a] | 1984[b] |
|---|---|---|---|
| Enforcement | $136.0 | $137.1 | $134.4 |
| Federal | 83.0 | 84.1 | 84.8 |
| State | 53.0 | 53.0 | 49.6 |
| Compliance assistance | 34.8 | 37.9 | 38.9 |
| Safety and health statistics | 17.9 | 21.0 | 16.2 |
| Technical support | 13.7 | 13.2 | 12.8 |
| Safety and health standards | 6.0 | 6.2 | 5.0 |
| Administration | 5.0 | 5.4 | 6.4 |
| TOTAL | $213.4 | $220.8 | $214.6 |

a Estimate. b Actual. Note: Obligations. Source: Office of Management & Budget

# R&D cost of weapons continues to escalate

The massive commitment of U.S. scientific and technological resources to the development of new weapons systems that has been building up these past four years will continue unabated. That is an unmistakably clear message contained in Secretary of Defense Caspar W. Weinberger's 1985 report to Congress.

The 314-page document was submitted earlier this month in support of the Administration's budget for fiscal 1986. That budget pegs the Department of Defense's research, development, testing, and evaluation program at $39.3 billion, up 25% from fiscal 1985 and 45% from fiscal 1984. Why the Pentagon insists it needs such massive increases in R&D funding becomes clear from the details given in Weinberger's report of the massive expense of developing modern weapons systems, particularly strategic systems.

For instance, the Trident II is a submarine-launched ballistic missile (SLBM). It is scheduled to be deployed in late 1989. It is of longer range and it carries more powerful nuclear warheads than the Trident I and Poseidon SLBMs that are currently in service. Trident II will be the first SLBM accurate enough to strike effectively at missile silos and other hardened targets.

Initial R&D on the Trident II was under way during the Carter Administration. The weapon is now at the full-scale development stage. Development funding of the Trident II reached $1.47 billion for fiscal 1984 and for 1985 it was $2.05 billion. For 1986 it is set at $2.17 billion and for 1987 at $1.72 billion.

A ballistic missile that is at an earlier stage of development is the so-called Midgetman. This is a relatively small, land-based weapon. It will weigh less than 30,000 lb and carry a single warhead. It will enter full-scale development during fiscal 1987 and will be deployed, in a mobile launcher system, beginning in the early 1990s. R&D funding for this missile and launcher are set at $625 million for fiscal 1986. Development funding, starting in fiscal 1987, will be much higher.

A strategic weapons system nearing the end of its development cycle is the MX intercontinental ballistic missile (ICBM). Development started more than a decade ago. Present plans call for the deployment of 100 of these missiles in existing Minuteman III silos beginning in late 1986. Each MX will carry 10 relatively large and very accurate nuclear warheads. As Weinberger explains, the MX "is the only near-term answer for providing a prompt capability to hold time-urgent Soviet assets at risk." This Pentagonese means, among other things, that MX theoretically has the ability to knock out large Soviet ICBMs in their silos. It reciprocates the potential ability of Soviet ICBMs to knock out any silo-based U.S. ICBM, including the MX itself. Development funding for MX was $1.96 billion in 1984. It is set at $1.70 billion for 1985. And it is slated to decline to $805 million for 1986.

Another strategic weapons system that, like MX, is moving from development to deployment is the B-1B bomber. The first of 100 production aircraft is off the assembly line. However, development funds are still being spent on the system—$465 million in fiscal 1985 and a proposed $367 million for fiscal 1986. Funding for development of a more advanced bomber scheduled for deployment in the mid-1990s is building up rapidly. But the amount is being withheld as classified information.

Another strategic program very much on the upswing in terms of R&D funding is the effort to explore the feasibility of protecting the territory of the U.S. and its allies from ballistic nuclear missiles. This program will be strictly limited to the research and very early development stages for some years. Anything more would violate the antiballistic missile treaty to which the U.S. is a party. Even so, very major monies are involved. Spending for what is now called the Strategic Defense Initiative for fiscal 1985 is $1.40 billion. For 1986 it will be $3.72 billion and for fiscal 1987, $4.91 billion.

The ultimate goal of such a shift to defensive systems is to move away from the present doctrine of deterring nuclear war by maintaining the ability to retaliate and obliterate any enemy who attacks (mutual assured destruction—MAD). The idea is to move to a doctrine of mutual assured defense. This would eventually render ballistic missiles impotent and lead to their elimination. Critics are not very impressed with the whole concept. They argue it never will be possible to defend population centers because missiles can readily be modified to stay ahead of developing defensive systems. Their greatest fear is that any systems developed under the initiative could end up being deployed only for the defense of missile silos. This would, in effect, exacerbate the uncertainties of MAD by pushing it to higher and more dangerous levels of technical action and counteraction as each side strove to maintain the viability and effectiveness of its retaliatory forces.

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**R&D funding for major strategic systems on the rise**

| $ Millions | Fiscal year 1984 | 1985 | 1986 |
|---|---|---|---|
| MX intercontinental ballistic missile | $1963 | $1700 | $ 804 |
| Small intercontinental ballistic missile (Midgetman) | 323 | 426 | 625 |
| Trident II submarine-launched ballistic missile | 1473 | 2044 | 2166 |
| B-1B bomber | 737 | 465 | 367 |
| Strategic defense initiative (Star Wars) | 50 | 1397 | 3722 |
| Strategic surveillance, command, and communication | 1072 | 1346 | 1384 |
| Advanced strategic missile systems | 74 | 98 | 174 |
| TOTAL | $5613 | $7419 | $9085 |

Source: Department of Defense